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DESI Power Objectives

To supply electricity and energy services to villages in joint ventures with local partners

Reliably, Cleanly and Profitably

CHOSEN INSTRUMENT

Indpendent Rural Power Producers (IRPPs)

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Independent Power Producers IPPs

IPPs pure-market instruments controlled by global financial forces

IPPs

- Maximise profits
- Maximise financial risk coverage for real and perceived risks
- More capital intensive than national internal financing
- Long completion cycles

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Independent Rural Power Producers IRPPs

IRPPs **social market** equivalent of the pure-market IPPs

IRPPs

- Shorter completion cycle (ca. 1 year)
- Lower investment costs in biomass gasification
- Risks shared locally and nationally
- Profitable over a longer timeframe

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DESI Power's IRPPs

DESI floats local cluster companies with local partners (DESI Power Orchha, DESI Power Kosi, etc.)

Minimum 1 MW installed capacity in one geographical proximity

- To ensure the financial base for continued Extension Services

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Target Markets

- Primary
  Non-electrified and “theoretically electrified” villages (most of rural India)

- Secondary market
  Small scale industries (losses due to power problems. Large scale diesel generation)

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Profile of DESI Customers

Rural micro industries for local value addition

- Agro processing
- Building materials (low cost housing)
- Workshops
- Cold storage users

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Profile of DESI Customers

Domestic
- Lighting
- Water

Housewives
- Cooking (energy efficient stoves)

Farmers
- Irrigation water
- Agro-forestry

Small Industries

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Financing package for DESI Power IRPPs

Planned

- Debt and Equity (Ratio on a case to case basis
- Equity: DESI / Local partner / Other investors

During current Commercial Demonstration Phase

- Private investments
- Ethical investments
- Grants
- DESI has provided most of the equity.

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Sources of Funds for Commercial IRPPs

- Promoters equity
- Local partner's equity
- Equity from conventional power utilities
- Ethical investment funds
- Grants from Foundations etc.
- MNES subsidy
- FCCC mechanisms: AIJ Pilot Phase, CDM, etc.
- Bank loans

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DESI Power Technologies

- Biomass (mostly residues and weeds) gasification
- Tiny hydro
- Small wind
- Biogas
- Solar PV (niche applications and biomass-poor regions)
- Hybridisation (with fossil fuel or other RETs)

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DESI's Business Plan:
Target for biomass-based IRPPs

Year	2000	2001	2002	2003	2004	2005
Annual Installed Capacity MW	1	2	5	15	30	60
Cumulative MW	1	3	8	23	53	113
Direct Jobs/year	100	200	500	1500	3000	6000
Direct Jobs Cumulative	100	300	800	2300	5300	11300

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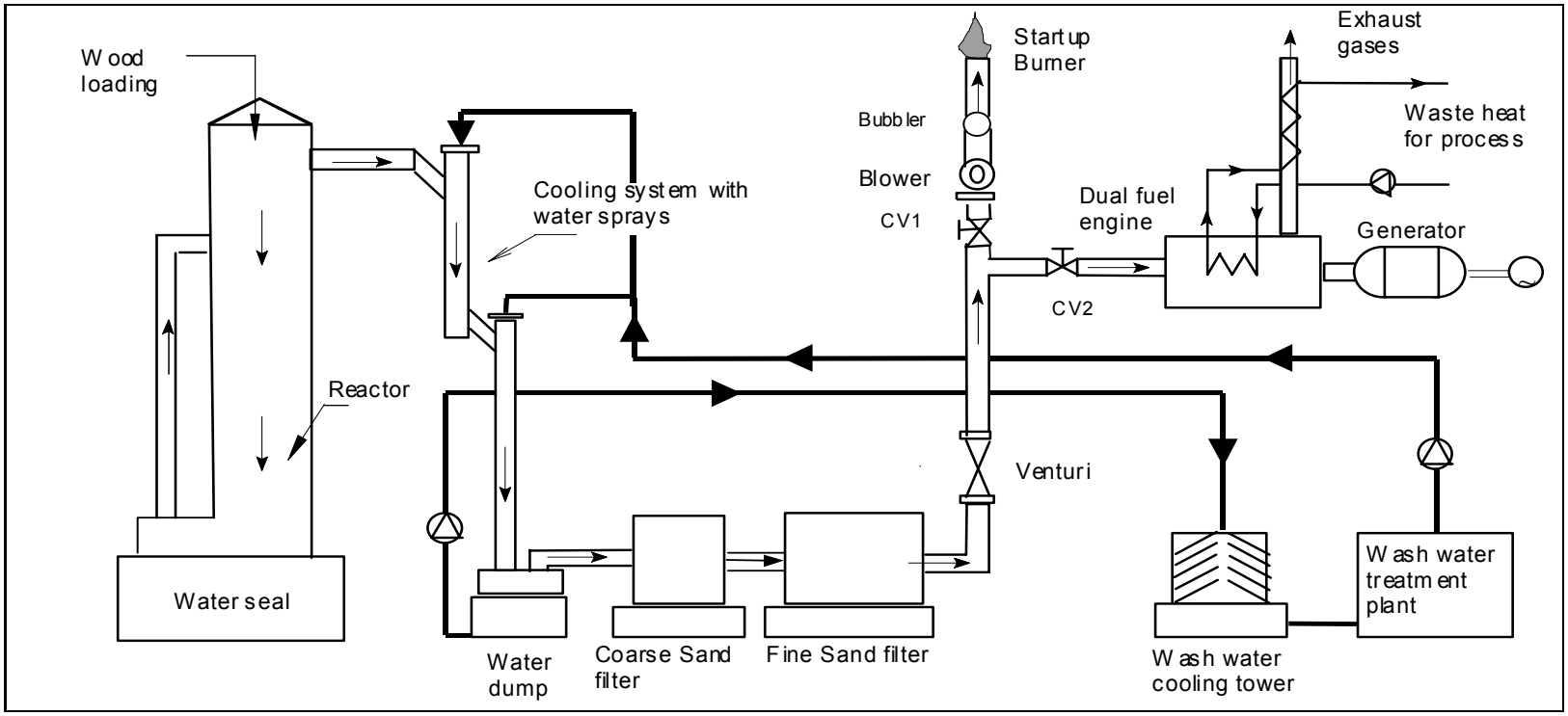
A TYPICAL SCHEMATIC ARRANGEMENT OF A POWER PLANT WITH AN IISc - DASAG GASIFICATION SYSTEM



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Specifications of Producer Gas Supplied From An IISc-DASAG Gasifier

Parameter	Specification
Type	Open top, down draft solid bio-mass gasifier
Feed stock	Any solid biomass with bulk density over 200 kg/m^3, moisture content less than 15%, cut to a maximum size of 60 mm x 20 mm x 20 mm.
Avg. Lower Calorific Value	4.6 $\pm$ 0.2 MJ / kg
Gas composition (% by volume)	CO: 20 $\pm$ 1%; CH_4: 3 $\pm$ 1%, H_2: 20 $\pm$ 1%, CO_2: 12 $\pm$ 1%;O_2: 0.1% (max); rest N_2
Turn down ratio (max/min load)	4:1
Average Specific Weight	1.12 kg / Nm^3
Parasitic plant loads	Water pump. Suction blower
Application	Diesel substitution of 80–85% achieved in diesel engines without any modification at above 75% of the rated load.
Gas quality:	Hot end / Cold end
	Tar: 70 $\pm$ 30 ppm / < 40 $\pm$ 10 ppm
	Particles: 600 $\pm$ 100 ppm / < 30 $\pm$ 10 ppm
Gasification efficiency (hot)	80 % to 85 % at full load (at 30% load about 5% reduction)
Particulate size distribution	0.7 - 2 microns
Specific wood consumption	1 kg/kWh with 15 % moisture content

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Biomass used in IISc open-top down-draft gasifiers

Species	Density (kg/m^3)	Moisture content [%]
Casuarina	550 - 650	15
Eucalyptus	400 - 650	15
Phadauk	1’050 - 1’100	15
Silver oak	250 - 300	20
European Pine	200 - 250	15 – 37
Mulberry stalk	300 - 350	15
Ipomea	200 - 250	15
Jungle wood	300 - 600	20
Coconut shell	1’100 - 1’200	15
Cotton stalk	150 - 200	20
Buynath	1’100 - 1200	10
Sawdust, Coffee husk and other briquettes	900 - 1000	12

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Plant performance DP Orchha

- Fuel used: Ipomea, Lantana
- Gasifier rating: 100 Kgs/hr
- Engine rating: 2x50 kWe
- Total no. of hours operated: 10,250
- Total kWh generated: 293,000
- Total oil saved: 70,000 liters
- Total CO2 saved: 170,000 Kgs

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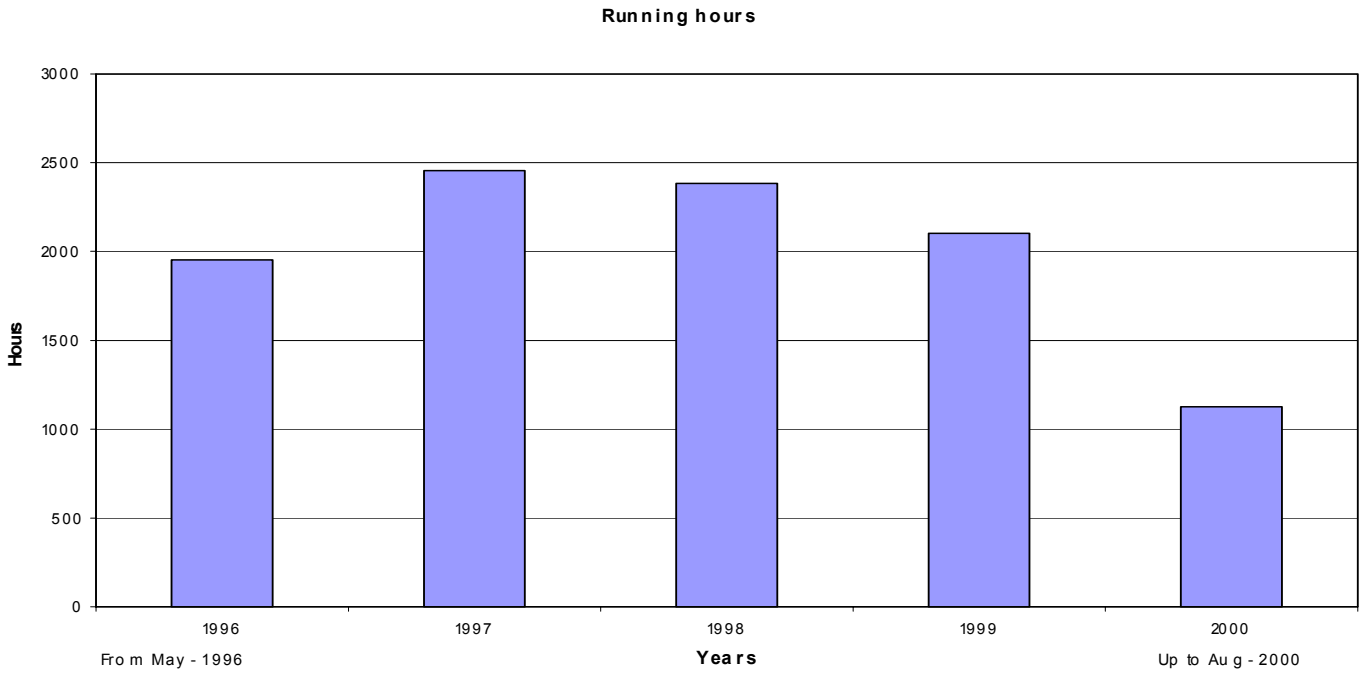
Plant performance Orchha



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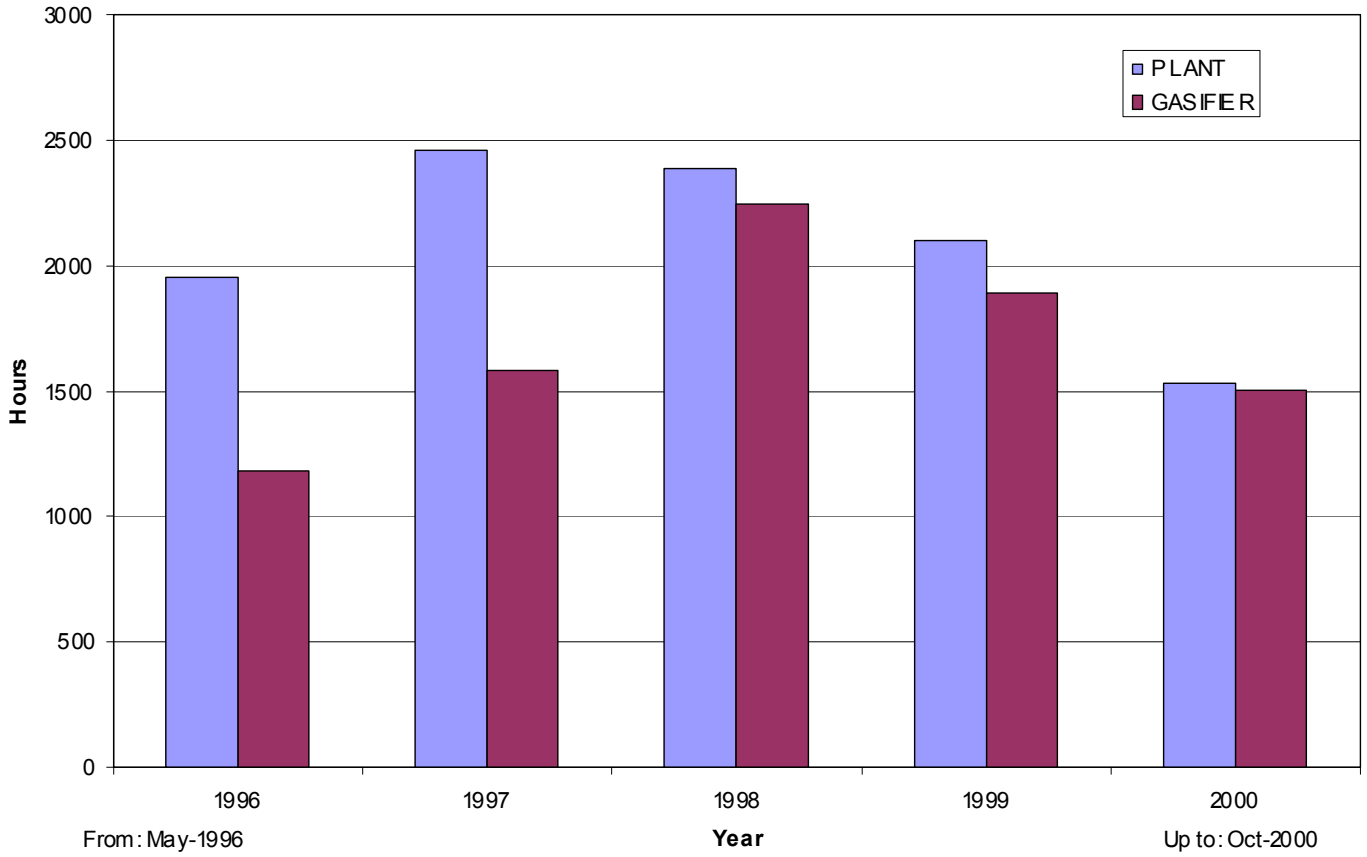
Orchha Operating Hours



IISc-DASAG Open-Top Down-Draft Gasifiers

The Swiss Biomass Gasification Technology Demonstration Programme

Chatel St Denis. 1995 - 2000.

Funded by the Swiss Government and the Technology Promoters.

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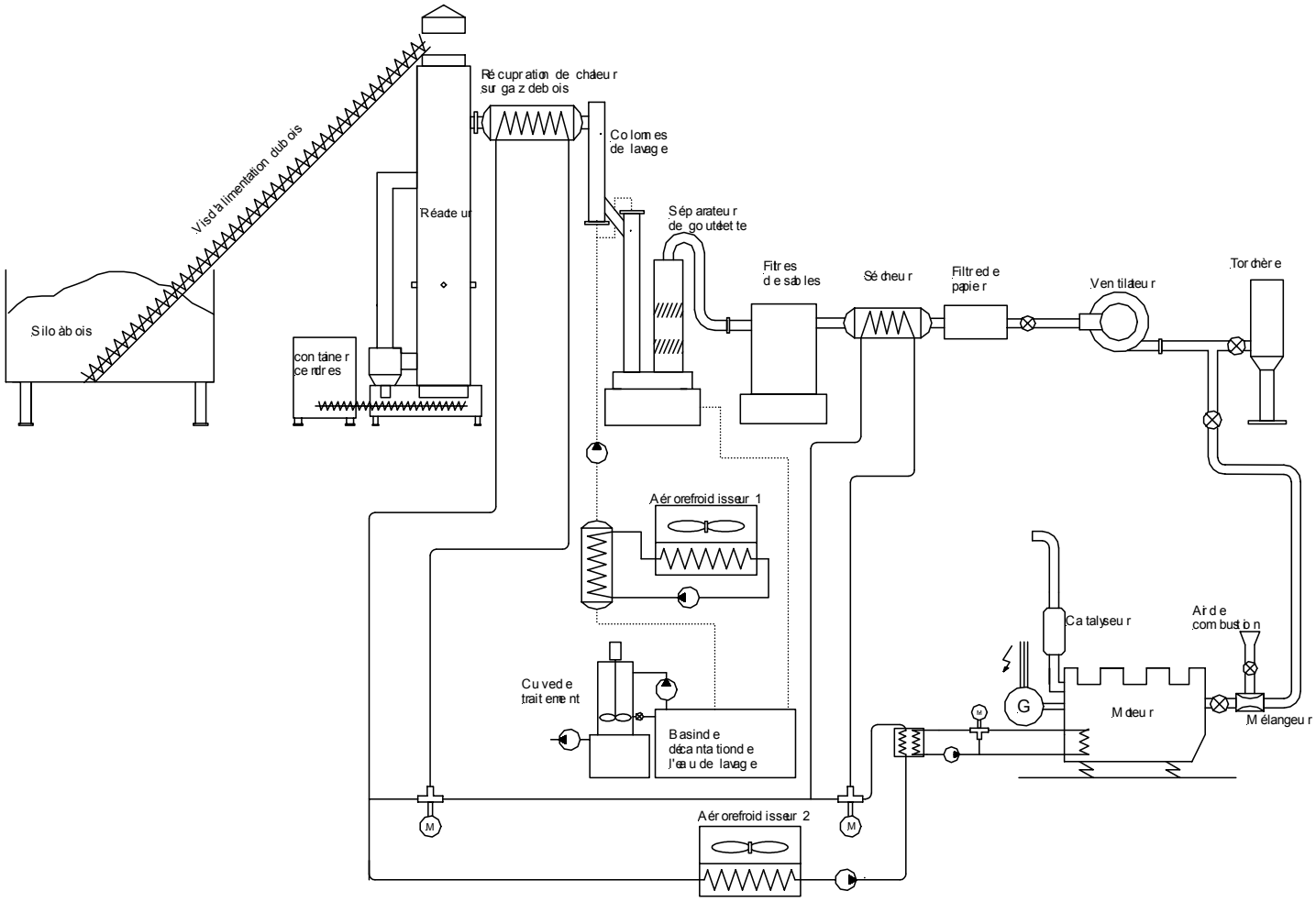
Vis d'alimentation du bois
Silo à bois
Réacteur
Récupration de chaleur sur gaz de bois
Colonnes de lavage
container cendres
Séparateur de goutelette
Filtres de sables
Sécheur
Filtre de papier
Ventilateur
Torchère
Aérorefroidisseur 1
Aérorefroidisseur 2
Cuve de traitement
Bassin de décantation de l'eau de lavage
Catalyseur
Air de combustion
Moteur
Mélangeur
G
M

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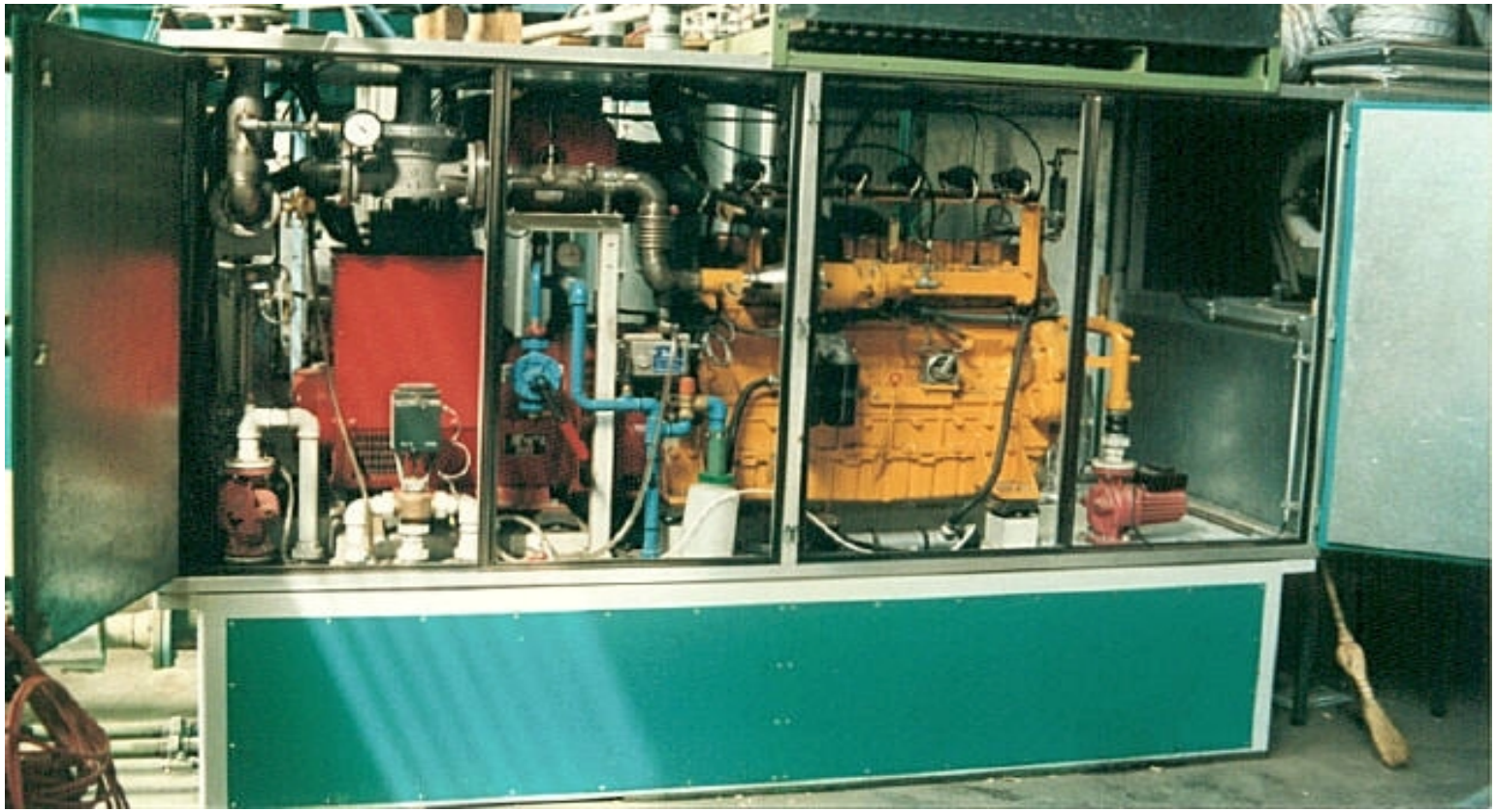
The Pure Gas Engine Operated with IISc - DASAG Gasifier in Switzerland



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Effluent Treatment

The contaminants in effluent discharged in the drains are lower than the Swiss norms.

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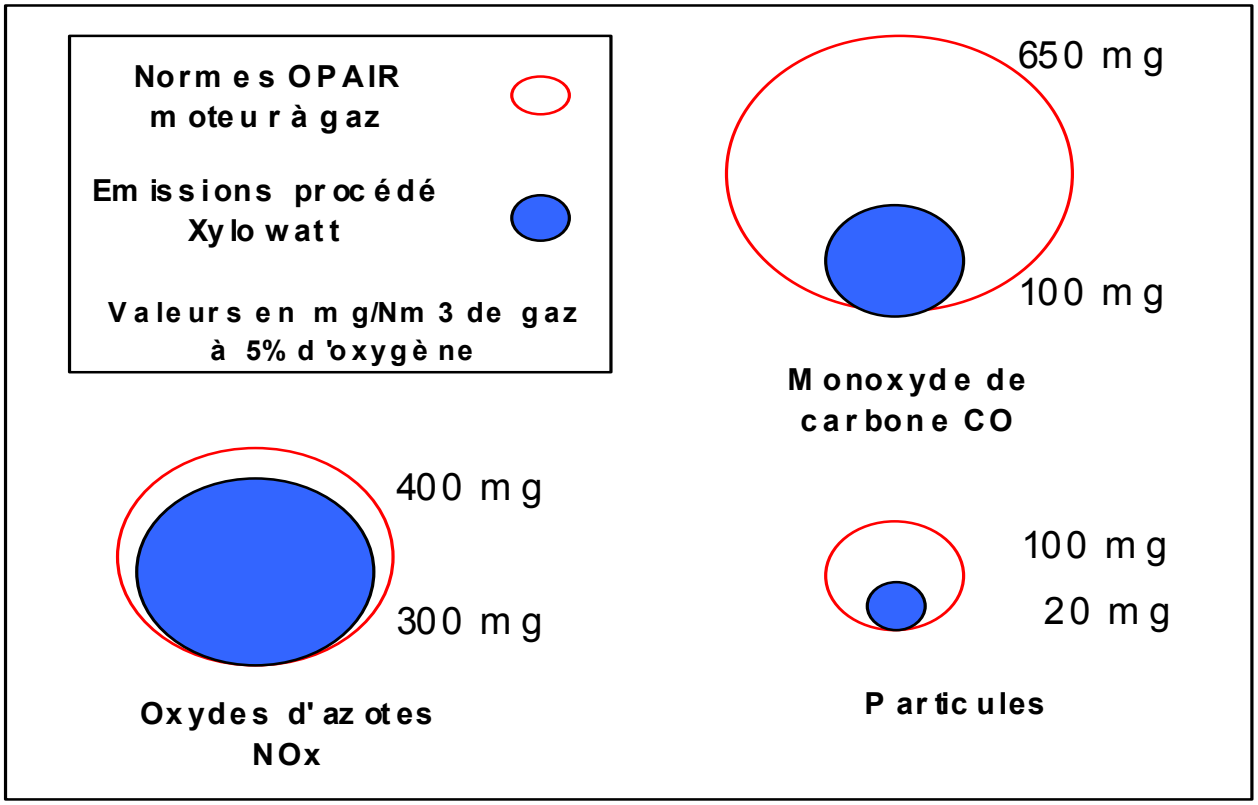
Gaseous Emissions



All Swiss norms can be met.

Polyaromatic hydrocarbons (PAH) concentrations of in the producer gas and in the engine exhaust are well below the statutory limits.

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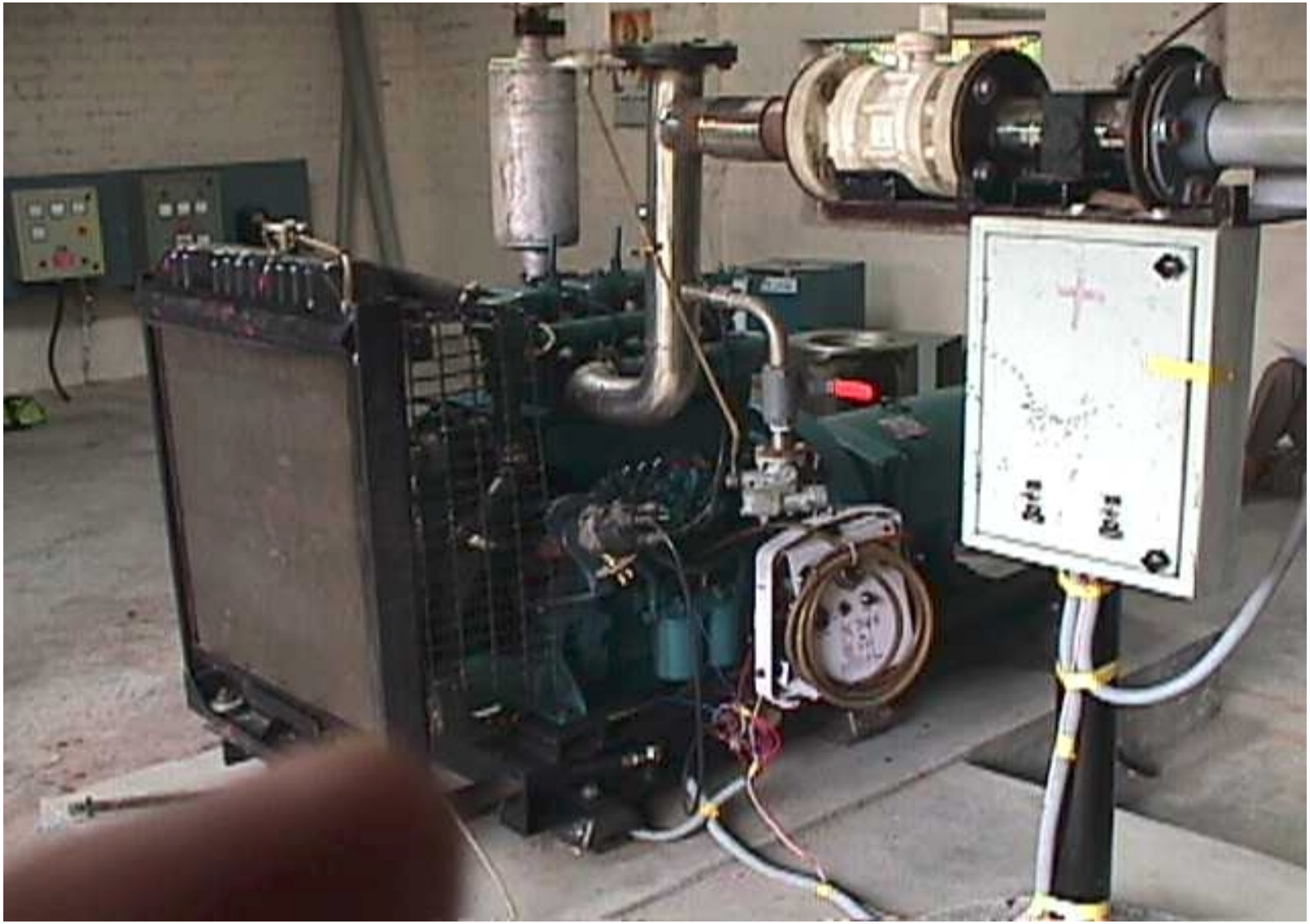

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Biomass-based Commercial Power Plants
Operational Experience

No.	Location	Capacity (kWe)	Fuel Mode	Total operating hours (Hrs)
1	Orchha	2 X50	DF	10428 (Oct00)
2	Kolar	1 X 24 1 X 20	DF PG	389 (Nov00) 152 (Nov00)
3	Ramanagaram	2 X 275	DF	1400 (Aug00)
4	Badadhara	1 x 40	DF	120 (May00)

DF: Duel Fuel Mode
PG: Pure Gas Mode

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Cluster Companies

Cluster company	Partner	Services provided
DP Orchha	A NGO	Handmade paper factory
DP Mahanadi	A community company	Sale of pumped water / Grid sale?
DP Kosi	A village jobs' co-operative	Micro-enterprises / water / lighting / process heat / cooking energy
DP Anantapur	A biomass co-operative	Grid sale / Fuel supply jobs. Agro-plantation planned.
DP Shanshi	A small scale industry	Reliable power.
DP MVIT	Engineering college	Reliable power for machines, laboratories and hostels.
DP Chitravathi	A power co-operative	Local industries / Grid.
DP SPG(MOU)	Engineering college	Reliable power for an industrial park.
DP GB (MOU)	A village SS industry	Reliable power.

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November 2000

INDEPENDENT RURAL POWER PRODUCERS (IRPPs) PROMOTED AND/OR BUILT BY DESI POWER

Plant No.	Cluster Company	Technical details		Fuel Mode	Biomass	Plant operating hours or commissioning date
		Gasifier rating kWe	Engine rating kWe			
1	DESI Power Orchha	100	2 engines of 50 kW.	Dual fuel (Future one PG)	Ipomea. Lantana.	10428 (0ct00). Nov00: conversion of one engine to PG
2	DESI Power Mahanadi	100	36 kW.	Dual fuel	Ipomea.	120 (Slow load built up)
3	Kolar (Private investor)	50	26 kW DF 21 kW SF	Dual fuel and Pure gas	Eucalyptus. Coconut fronds. Lantana. Ipomea.	Total 541 h (Nov00)
4	DESI Power Kosi	50	36 kW.	Dual fuel	Ipomea. Agro-residue briquettes.	January 2001
5	DESI Power Anantapur	135	102	Pure gas	Juliflora.	April 2001
6	DESI Power Shanshi	100	100 20	Dual fuel	Mulberry shoots.	May 2001
7	DESI Power MVIT	60	Existing	Dual fuel	Mulberry shoots. Eucalyptus.	April 2001
8	DESI Power Chitravathi	100	60	Pure gas	Mulberry shoots. Eucalyptus. Agro-residue briquettes	June 2001
9	DESI Power PSG (MOU)	135	102	Pure gas	Coconut shell and fronds	July 2001
10	DESI Power GB (MOU)	135	102	Pure gas	Agro-residue briquettes. Ipomea.	July 2001

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Training Package And Extension Services

Conventional training package suitable for locally available manpower (including accounts and management).

Interactive computer based training package for less educated villagers: lessons, tests and regular revisions.

Refresher and retraining courses.

Maintenance management system.

Monthly Performance Audit: (technical, managerial and financial results and course-correction lists)

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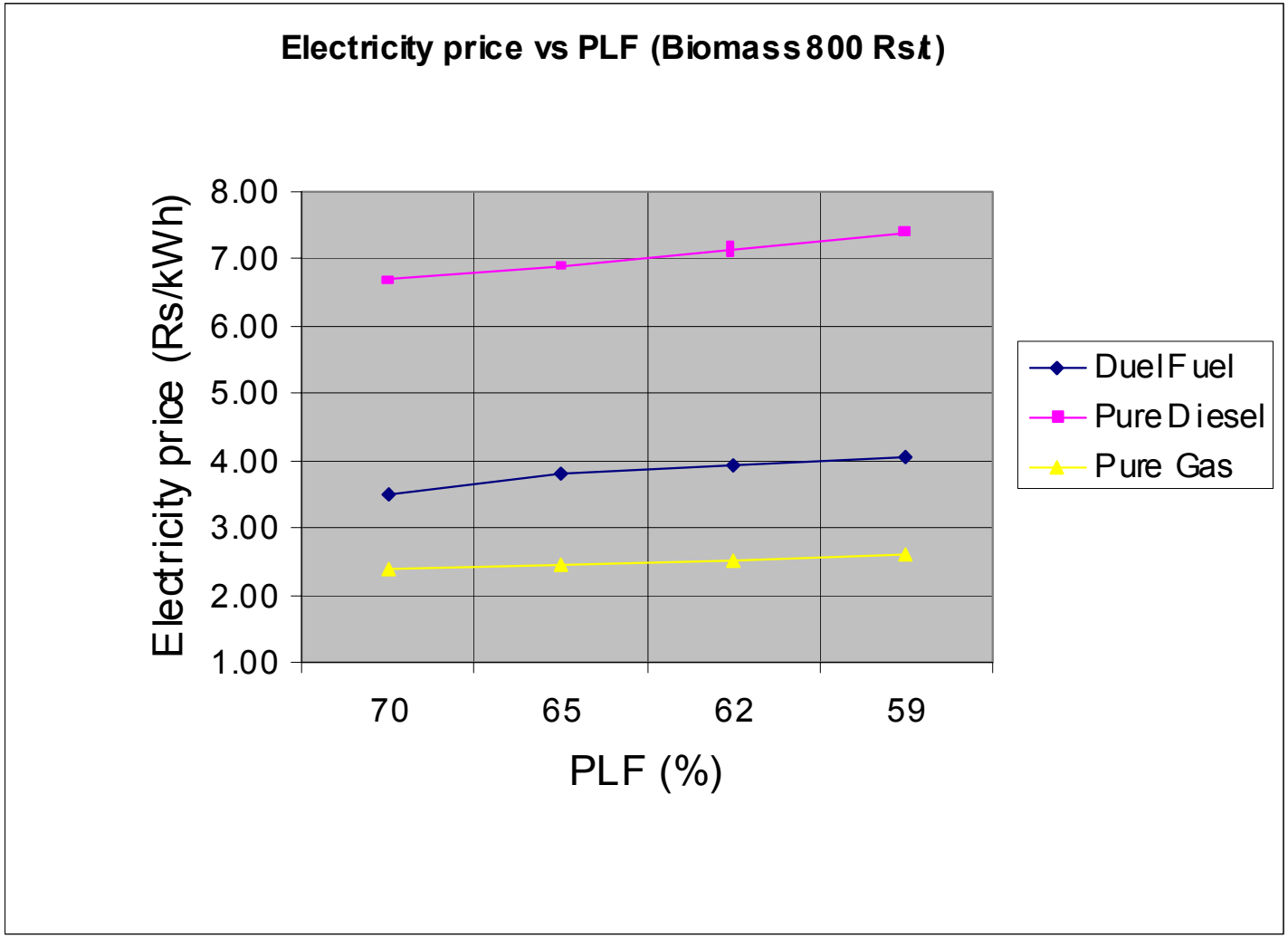
Electricity price vs PLF (Biomass 800 Rs/t)
Electricity price (Rs/kWh)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
70
65
62
59
PLF (%)
Duel Fuel
Pure Diesel
Pure Gas

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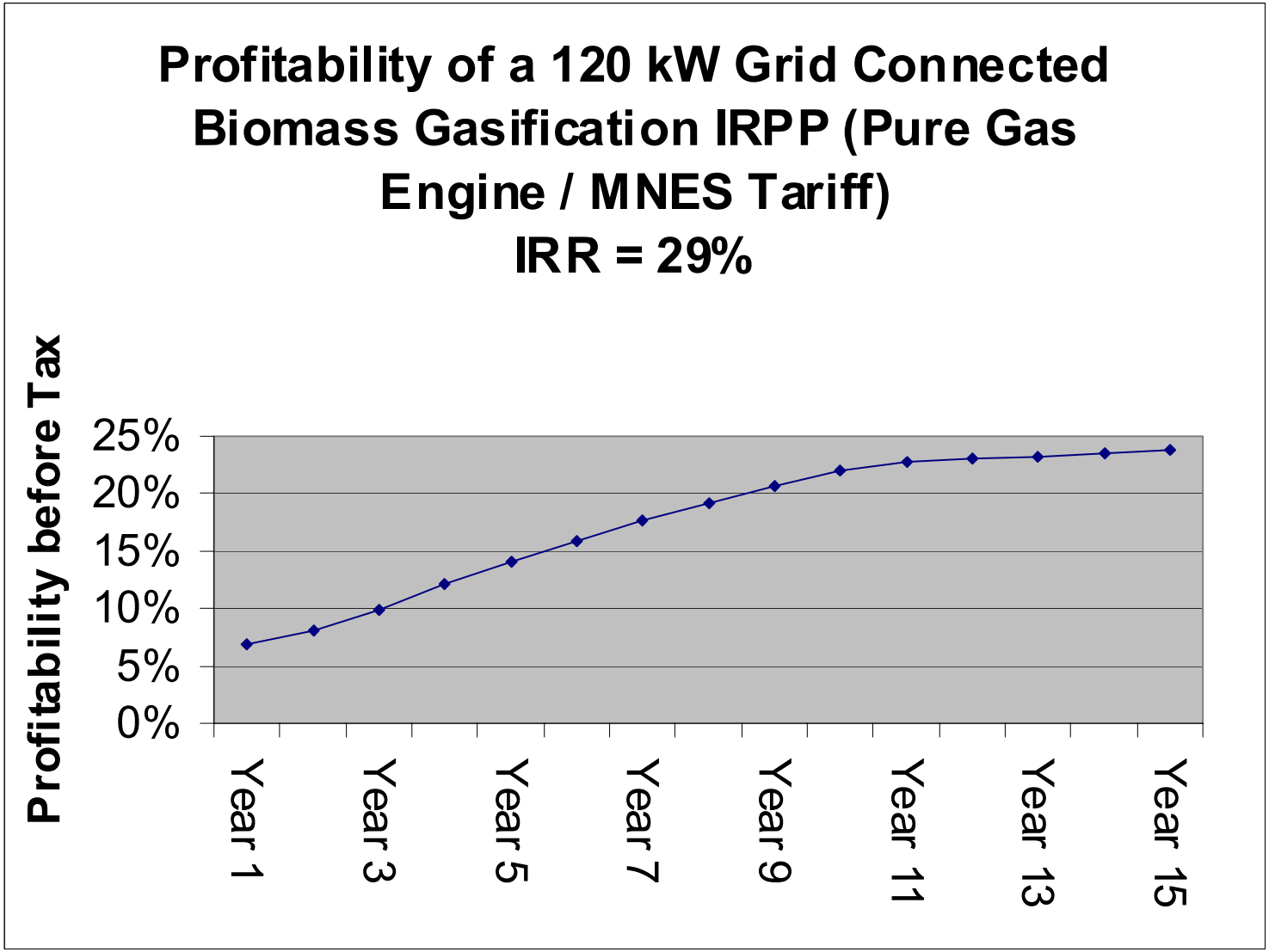
Profitability of a 120 kW Grid Connected Biomass Gasification IRPP (Pure Gas Engine / MNES Tariff)
IRR = 29%
Profitability before Tax
25%
20%
15%
10%
5%
0%
Year 1
Year 3
Year 5
Year 7
Year 9
Year 11
Year 13
Year 15

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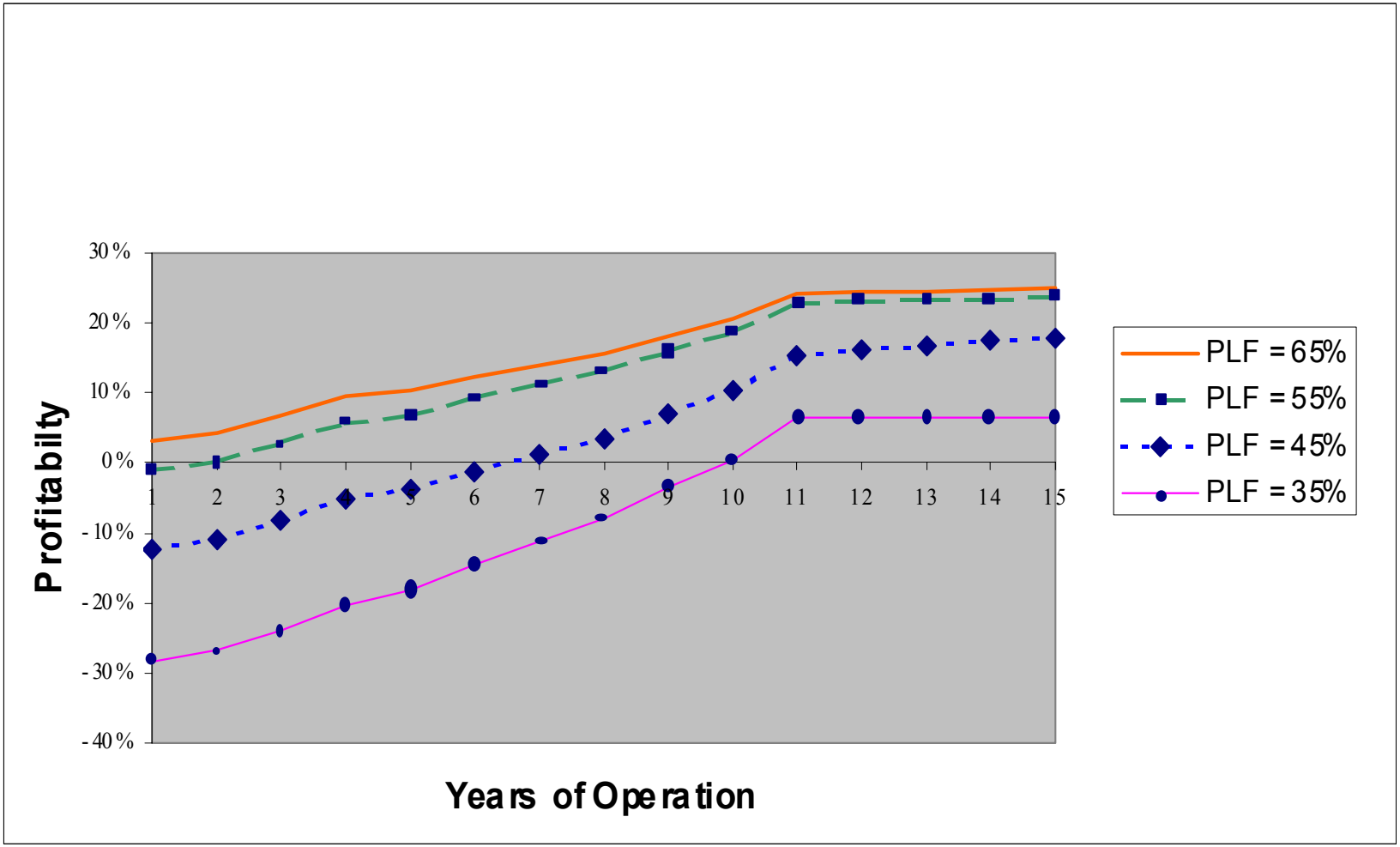
A 100 kWe IRPP based on biomass gasification (dual fuel engine).
Pre Tax Profit Ratio as a Function of PLF, Plant Load



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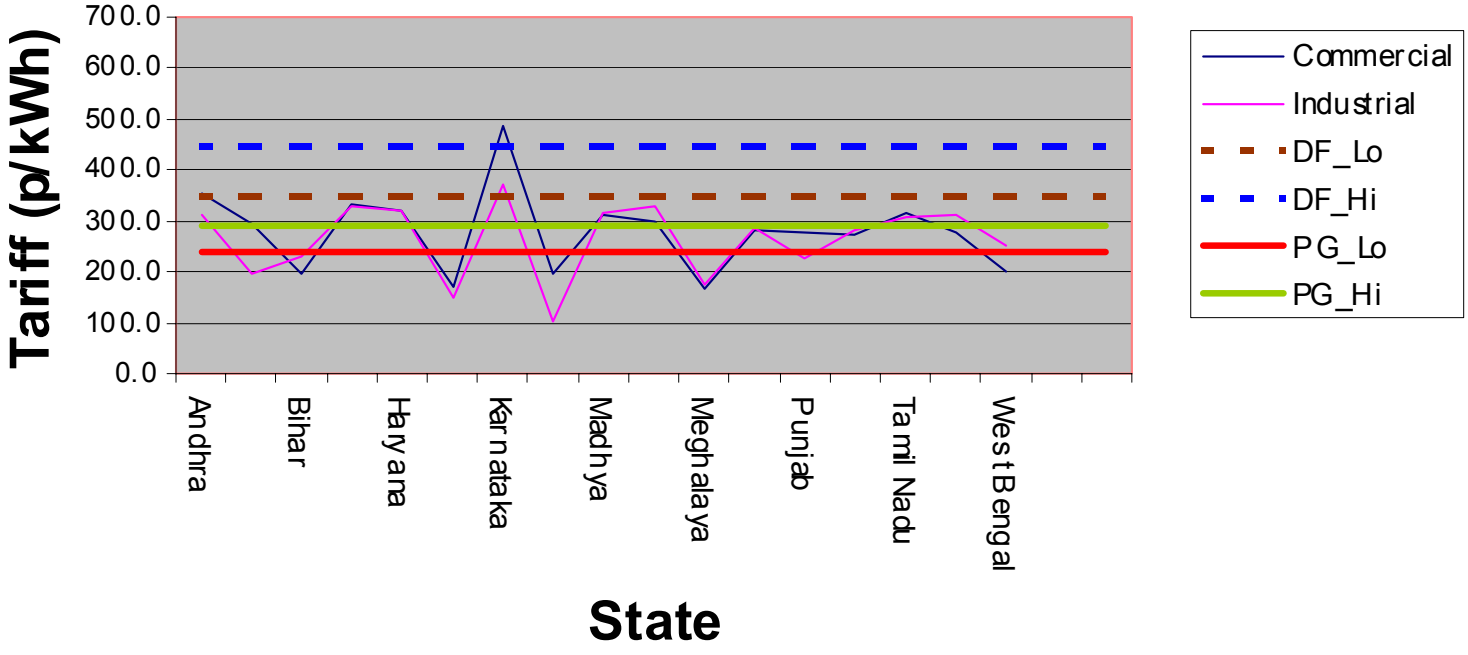
Electricity Tariff (1997-98): Comparison with PG



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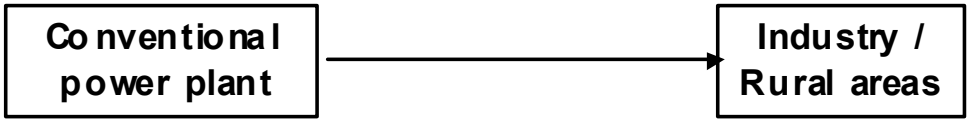
REAL COST OF POWER

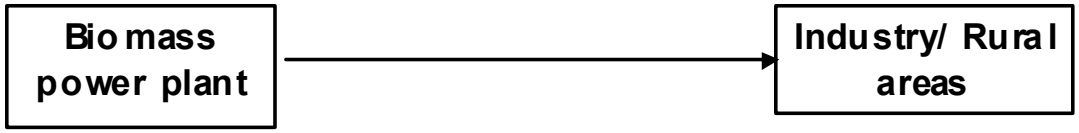
CONVENTIONAL POWER:

Generation	T&D	Power at user end
1 MW	**(Losses 30%)**	**0.7 MW**
Rs. 40 million / MW	Rs. 5 million	Rs. 64 million / MW-End Use



DECENTRALISED BIOMASS POWER:

Generation	T&D	Energy at user end
1 MW	**(Losses 10%)**	**0.9 MW**
Rs. 35 million / MW	**Rs. 3 million**	**Rs. 42 million / MW-End Use**



Primary energy saved compared to grid supply: 20%
Saving in investment compared to grid supply: 34%

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DESI's Parameters for Success

- People: Local ownership / partnership. Linkage to biomass management and supply.
- People: Affordability through local value addition and jobs.
- People: Integration of R&D, Engineering, Supply and Services.

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DESI's Parameters for Success

- Technology: Solid Research, Innovative Designs, Debugging in the field, Long Duration Testing.
- Technology: Maintenance management
- Training and continuous re-training.
- Extension Services : near at hand.
- Linkage: Economy and Ecology

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DESI's WISH LIST

Make

Access to electricity a constitutional human right of Indian citizens

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DESI's WISH LIST

Create a
Legal Framework for a Decentralised Power Sector

- Make it a full and equal partner of the centralised sector

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DESI's WISH LIST

Establsih A Framework for Commercialising
Rural Electricity and Energy Services

Mandate clean technologies for villages
Give incentives for renewable energy

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DESI's WISH LIST

- Put a small levy on fossil fuels to fund clean electricity and energy services (an investment and loan fund)
- Create financing mechanisms to provide focused access to funds (like the current Rural Electrification Corporation)
- Provide incentives for private investment

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DESI's WISH LIST

Electricity Regulatory Commissions should

- Permit building, generation, and selling of electricity and energy services by IRPPs within a given area *without hindrance*

- Create uniform rules throughout the country
  (e.g., definition of eligibility of IRPPs for getting investment funds)

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DESI's WISH LIST

Electricity Regulatory Commissions should

- Mandate T&D companies to accept grid connection irrespective of rating
  (under defined technical specifications and safety conditions)
- Set fair conditions for wheeling
- Set uniform guidelines for grid's purchase of IRPP electricity
- Give incentives for co-generation